E/ECE/324
E/ECE/TRANS/505 } Rev.2/Add.100

28 February 1997

AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM TECHNICAL PRESCRIPTIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES AND THE CONDITIONS FOR RECIPROCAL RECOGNITION OF APPROVALS GRANTED ON THE BASIS OF THESE PRESCRIPTIONS */

(Revision 2, including the amendments entered into force on 16 October 1995)

Addendum 100: Regulation No. 101

Date of entry into force: 1 January 1997

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF PASSENGER CARS EQUIPPED WITH AN INTERNAL COMBUSTION ENGINE WITH REGARD TO THE MEASUREMENT OF THE EMISSION OF CARBON DIOXIDE AND FUEL CONSUMPTION

UNITED NATIONS

---

*/ Former title of the Agreement:

Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958.

GE.97-20507

BEST COPY
AVAILABLE

Regulation No. 101

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF PASSENGER CARS EQUIPPED WITH AN INTERNAL COMBUSTION ENGINE WITH REGARD TO THE MEASUREMENT OF THE EMISSION OF CARBON DIOXIDE AND FUEL CONSUMPTION

CONTENTS

REGULATION		Page
1.	Scope	4
2.	Definitions	4
3.	Application for approval	4
4.	Approval	5
5.	Specifications and tests	6
6.	Modification and extension of approval of the approved type	7
7.	Conditions of extension of the type approval for vehicle type	8
8.	Special provisions	8
9.	Conformity of production	8
10.	Penalties for non-conformity of production	17
11.	Production definitely discontinued	17
12.	Names and addresses of technical services responsible for conducting approval tests and of administrative departments	17

ANNEXES

Annex 1 - Essential characteristics of the engine and information concerning the conduct of tests

Annex 2 - Communication concerning the approval or extension or refusal or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to Regulation No. 101

Annex 3 - Arrangements of approval marks

Annex 4 - Method of measuring emissions of carbon dioxide and fuel consumption

1. SCOPE

This Regulation applies to the measurement of the emission of carbon dioxide (CO_2) and fuel consumption from all motor vehicles of category M1 1/.

2. DEFINITIONS

For the purposes of this Regulation,

2.1. "Approval of a vehicle" means the approval of a vehicle type with regard to the measurement of the fuel consumption;

2.2. "Vehicle type" means a category of power driven vehicles which do not differ in such essential respects as body, engine, transmission, tyres and unladen mass;

2.3. "Unladen mass" means the mass of the vehicle in running order without crew, passengers or load, but with the fuel tank full and the usual set of tools and spare wheel on board, where applicable;

2.4. "Reference mass" means the unladen mass of the vehicle increased by a uniform figure of 100 kg;

2.5. "Maximum mass" means the technically permissible maximum mass declared by the manufacturer (this mass may be greater than the maximum mass authorised by the national administration);

2.6. "Cold start device" means a device which enriches the air/fuel mixture of the engine temporarily, to assist starting;

2.7. "Starting aid" means a device which assists engine starting without enrichment of the air/fuel mixture, e.g. glow plug, changed injection timing, etc.;

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a vehicle type with regard to the measurement of the emission of carbon dioxide and fuel consumption shall be submitted by the vehicle manufacturer or by his duly accredited representative.

3.2. It shall be accompanied by the under-mentioned documents in triplicate and the following particulars:

1/ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3) (document TRANS/SC1/WP29/78/Amend.4).

3.2.1. A description of the engine type comprising all the particulars referred to in annex 1. At the request of the technical service in charge of the tests or the manufacturer, complementary technical information could be considered for specific vehicles which are particularly fuel efficient.

3.2.2. Description of the basic features of the vehicle, including those used in drafting annex 2.

3.3. A vehicle, representative of the vehicle type to be approved, shall be submitted to the technical services responsible for conducting approval tests. During the test, the technical service will check that this vehicle conforms to the limit values applicable to that type, as described in Regulation No. 83.

3.4. The competent authority shall verify the existence of satisfactory provisions to ensure an effective check of conformity of production before approval of the vehicle type is granted.

4. APPROVAL

4.1. If the emissions of CO_2 and fuel consumption of the vehicle type submitted for approval pursuant to this Regulation have been measured according to the conditions specified in paragraph 5 below, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 00 for the Regulation in its original form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.

4.3. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement applying this Regulation by means of a form conforming to the model in annex 2 to this Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.4.1. a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval 2/ ;

4.4.2. the number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1.

4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1 need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

4.6. The approval mark shall be clearly legible and be indelible.

4.7. The approval mark shall be placed close to or on the vehicle data plate.

4.8. Annex 3 to this Regulation gives examples of arrangements of the approval mark.

5. SPECIFICATIONS AND TESTS

5.1. General

The components liable to affect the emissions of CO_2 and fuel consumption shall be so designed, constructed and assembled as to enable the vehicle, in normal use, despite the vibrations to which it may be subjected, to comply with the provisions of this Regulation.

2/ 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 (vacant), 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30-36 (vacant) and 37 for Turkey. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

5.2. Description of tests

5.2.1. The emissions of CO_2 shall be measured during the test cycle simulating the urban and extra-urban driving patterns as described in appendix 1 of annex 4 of Regulation No. 83.

5.2.2. The results of the test must be expressed as CO_2 emissions in grams per kilometre (g/km) rounded to the nearest whole number.

5.2.3. Fuel consumptions are calculated according to paragraph 1.5. of annex 4 by the carbon balance method using the measured emissions of CO_2 and the other carbon related emissions (CO and HC). The results will be rounded to the first decimal place.

5.2.4. The appropriate reference fuel as defined in annex 9 of Regulation No. 83 must be used for testing.

For the purpose of calculation mentioned in paragraph 5.2.3., the following fuel characteristics will be used:

(a) density: measured on the test fuel according to ISO 3675 or an equivalent method;

(b) hydrogen-carbon ratio: fixed values will be used which are 1.85 for gasoline and 1.86 for diesel.

5.3. Interpretation of results

5.3.1. The CO_2 value adopted as the type approval value shall be the value declared by the manufacturer if the value measured by the technical service does not exceed the declared value by more than 4 per cent. The measured value can be lower without any limitations.

5.3.2. If the measured value of CO_2 exceeds the manufacturer's declared CO_2 value by more than 4 per cent, then another test is run on the same vehicle.

When the average of the two test results does not exceed the manufacturer's declared value by more than 4 per cent, then the value declared by the manufacturer is taken as the type approval value.

5.3.3. If the average still exceeds the declared value by more than 4 per cent, a final test is run on the same vehicle. The average of the three test results is taken as the type approval value.

6. MODIFICATION AND EXTENSION OF APPROVAL OF THE APPROVED TYPE

6.1. Every modification of the approved type shall be notified to the administrative department which approved the type. The department may then either:

6.1.1. Consider that the modifications made are unlikely to have an appreciable adverse effect on the values of CO_2 and fuel consumption

and that, in this case, the original approval will be valid for the modified vehicle type; or

6.1.2. Require a further test report from the technical service responsible for conducting the tests according to conditions in paragraph 7 of this Regulation.

6.2. Confirmation or extension of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 4.3. to the Parties to the 1958 Agreement applying this Regulation.

6.3. The competent authority which grants the extension of the approval shall assign a series number for such an extension and inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in annex 2 to this Regulation.

7. CONDITIONS OF EXTENSION OF THE TYPE APPROVAL FOR VEHICLE TYPE

7.1. The type approval can be extended to vehicles from the same type or from a different type differing with regard to the following characteristics of annex 2 if the CO_2 emissions measured by the technical service do not exceed by more than 4 per cent the type approved value:

7.1.1. Mass.

7.1.2. Maximum authorized mass.

7.1.3. Type of bodywork: saloon, estate, coupé.

7.1.4. Overall gear ratios.

7.1.5. Engine equipment and accessories.

8. SPECIAL PROVISIONS

In the future, vehicles with special fuel efficient technologies may be offered which could be submitted to complementary testing programmes. These would be specified at a later stage which can be claimed by the manufacturer in order to demonstrate the advantages of the solution.

9. CONFORMITY OF PRODUCTION

9.1. Vehicles approved to this Regulation shall be so manufactured as to conform to the type approved vehicle.

9.2. So as to verify that the conditions set out in paragraph 9.1. are complied with, appropriate production checks shall be carried out.

9.3. As a general rule, measures to ensure the conformity of production with regard to CO_2 emissions from vehicles is checked on the basis of the description in the type approval certificate conforming to the model in annex 2 of this Regulation.

The control of production conformity is based on an assessment made by the competent authority of the manufacturer's auditing procedure in order to ensure conformity of the vehicle type with respect to the emission of pollutants.

If the authority is not satisfied with the standard of the manufacturer's auditing procedure, they may require that verification tests be carried out on vehicles in production.

9.3.1. If a measurement of the emissions of CO_2 must be carried out on a vehicle type that has had one or several extensions, the tests will be carried out on the vehicle(s) available at the time of the test (vehicle(s) described in the first document or in subsequent extensions).

9.3.1.1. Conformity of the vehicle for the CO_2 test.

9.3.1.1.1. Three vehicles are randomly taken in the series and are tested as described in paragraph 1.4. of annex 4.

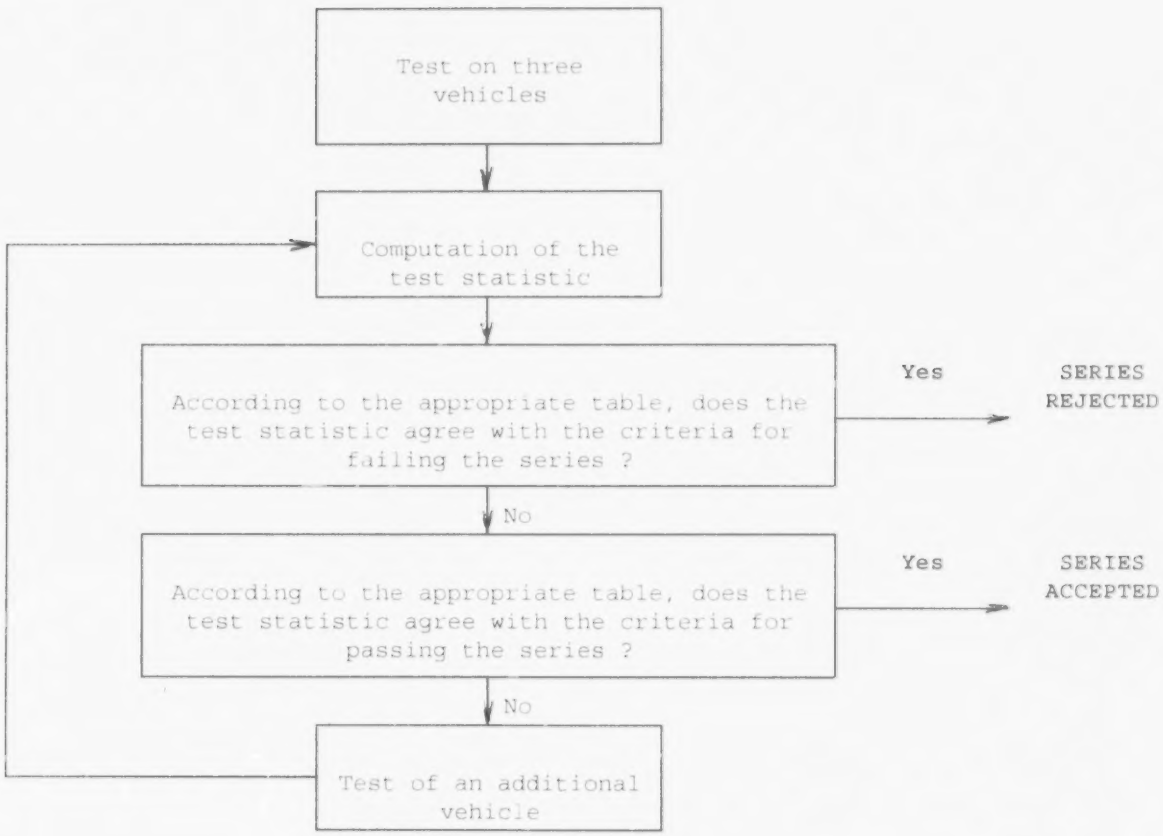
9.3.1.1.2. If the authority is satisfied with the production standard deviation given by the manufacturer, the tests are carried out according to paragraph 9.2.

If the authority is not satisfied with the production standard deviation given by the manufacturer, the tests are carried out according to paragraph 9.3.

9.3.1.1.3. The production of a series is regarded as conforming or non-conforming, on the basis of tests on the three sampled vehicles, once a pass or fail decision is reached for CO_2, according to the test criteria applied in the appropriate table.

If no pass or fail decision is reached for CO_2, a test is carried out on an additional vehicle (see Figure 1).

Figure 1


Test on three vehicles
Computation of the test statistic
According to the appropriate table, does the test statistic agree with the criteria for failing the series ?
Yes
SERIES REJECTED
No
According to the appropriate table, does the test statistic agree with the criteria for passing the series ?
Yes
SERIES ACCEPTED
No
Test of an additional vehicle

9.3.1.2. Notwithstanding the requirements of paragraph 1.1.1. of annex 4, the tests will be carried out on vehicles which have not travelled any distance.

9.3.1.2.1. However, at the request of the manufacturer, the tests will be carried out on vehicles which have been run-in a maximum of 15,000 km.

In this case, the running-in procedure will be conducted by the manufacturer who shall undertake not to make any adjustments to those vehicles.

9.3.1.2.2. If the manufacturer asks to conduct a running-in procedure ('x' km, where x ≤ 15,000 km), it may be carried out as follows:

the emissions of CO_2 will be measured at zero and at 'x' km on the first tested vehicle (which can be the type approval vehicle);

the evolution coefficient (EC) of the emissions between zero and 'x' km will be calculated as follows:

$$EC = \frac{Emissions\ at\ x\ km}{Emissions\ at\ zero\ km}$$

It may be less than 1.

The following vehicles will not be subjected to the running-in procedure, but their zero km emissions will be modified by the evolution coefficient, EC.

In this case, the values to be taken will be:

the value at 'x' km for the first vehicle;

the values at zero km multiplied by the evolution coefficient for the following vehicles.

9.3.1.2.3. As an alternative to this procedure, the car manufacturer can use a fixed evolution coefficient, EC, of 0.92 and multiply all values of CO_2 measured at zero km by this factor.

9.3.1.2.4. The reference fuels described in annex 9 of Regulation No. 83 shall be used for this test.

9.4. Conformity of production when manufacturer's statistical data is available.

9.4.1. The following sections describe the procedure to be used to verify the CO_2 conformity of production requirements when the manufacturer's production standard deviation is satisfactory.

9.4.2. With a minimum sample size of three the sampling procedure is set so that the probability of a lot passing a test with 40 per cent of the production defective is 0.95 (producer's risk = 5 per cent) while the probability of a lot being accepted with 65 per cent of the production defective is 0.1 (consumer's risk = 10 per cent).

9.4.3. The following procedure is used (see Figure 1).

Let L be the natural logarithm of the CO_2 type approval value:

x_i = the natural logarithm of the measurement for the i-th vehicle of the sample;

s = an estimate of the production standard deviation (after taking the natural logarithm of the measurements);

n = the current sample number.

9.4.4. Compute for the sample, the test statistic quantifying the sum of the standardized deviations to the limit and defined as:

$$\frac{1}{s}\sum_{i=1}^{n}(L - x_i)$$

9.4.5. Then:

9.4.5.1. if the test statistic is greater than the pass decision number for the sample given in Table 1, a pass decision is reached;

9.4.5.2. if the test statistic is less than the fail decision number for the sample size given in Table 1, a fail decision is reached;

9.4.5.3. otherwise, an additional vehicle is tested according to paragraph 1.4. of annex 4 and the procedure is applied to the sample with one unit more.

Table 1

Sample Size (cumulative number of vehicles tested)	**Pass Decision No.**	**Fail Decision No.**
(a)	(b)	(c)
3	3.327	-4.724
4	3.261	-4.790
5	3.195	-4.856
6	3.129	-4.922
7	3.063	-4.988
8	2.997	-5.054
9	2.931	-5.120
10	2.865	-5.185
11	2.799	-5.251
12	2.733	-5.317
13	2.667	-5.383
14	2.601	-5.449
15	2.535	-5.515
16	2.469	-5.581
17	2.403	-5.647
18	2.337	-5.713
19	2.271	-5.779
20	2.205	-5.845
21	2.139	-5.911
22	2.073	-5.977
23	2.007	-6.043
24	1.941	-6.109
25	1.875	-6.175
26	1.809	-6.241
27	1.743	-6.307
28	1.677	-6.373
29	1.611	-6.439
30	1.545	-6.505
31	1.479	-6.571
32	-2.112	-2.112

9.5. Conformity of production when manufacturer's statistical data is unsatisfactory or unavailable.

9.5.1. The following sections describe the procedure to be used to verify the CO_2 conformity of production requirements when the manufacturer's evidence of production standard deviation is either unsatisfactory or unavailable.

9.5.2. With a minimum sample size of three the sampling procedure is set so that the probability of a lot passing a test with 40 per cent of the production defective is 0.95 (producer's risk = 5 per cent) while the probability of a lot being accepted with 65 per cent of the production defective is 0.1 (consumer's risk = 10 per cent).

9.5.3. The measurement of CO_2 is considered to be log normally distributed and should first be transformed by taking the natural logarithms. Let m_o and m denote the minimum and maximum sample sizes respectively (m_o = 3 and m = 32) and let n denote the current sample number.

9.5.4. If the natural logarithms of the measurements in the series are x_1, x_2, ..., x_j and L is the natural logarithm of the CO_2 type approval value, then define:

$$d_j = x_j - L$$

$$\bar{d}_n = \frac{1}{n} \sum_{j=1}^{n} d_j$$

$$v^2_n = \frac{1}{n} \sum_{j=1}^{n} (d_j - \bar{d}_n)^2$$

9.5.5. Table 2 shows values of the pass (A_n) and fail (B_n) decision numbers against current sample number. The test statistic is the ratio $\bar{d}_n / v_n$ and shall be used to determine whether the series has passed or failed as follows:

for $m_o \leq n \leq m$:

9.5.5.1. pass the series if $\bar{d}_n / v_n \leq A_n$;

9.5.5.2. fail the series if $\bar{d}_n / v_n \geq B_n$

9.5.5.3. take another measurement if $A_n < \bar{d}_n / v_n < B_n$.

9.5.6. Remarks

The following recursive formulae are useful for computing successive values of the test statistic:

$$\bar{d}_n = \left(1 - \frac{1}{n}\right) \bar{d}_{n-1} + \frac{1}{n} d_n$$

$$v_n^2 = \left(1 - \frac{1}{n}\right) v_{n-1}^2 + \frac{(\bar{d}_n - d_n)^2}{n - 1}$$

$(n = 2, 3, \ldots; \ \bar{d}_1 = d_1; \ v_1 = 0)$

Table 2

Sample Size (cumulative number of vehicles tested) n	**Pass Decision No.** A_n	**Fail Decision No.** B_n
(a)	(b)	(c)
3	-0.80381	16.64743
4	-0.76339	7.68627
5	-0.72982	4.67136
6	-0.69962	3.25573
7	-0.67129	2.45431
8	-0.64406	1.94369
9	-0.61750	1.59105
10	-0.59135	1.33295
11	-0.56542	1.13566
12	-0.53960	0.97970
13	-0.51379	0.85307
14	-0.48791	0.74801
15	-0.46191	0.65928
16	-0.43573	0.58321
17	-0.40933	0.51718
18	-0.38266	0.45922
19	-0.35570	0.40788
20	-0.32840	0.36203
21	-0.30072	0.32078
22	-0.27263	0.28343
23	-0.24410	0.24943
24	-0.21509	0.21831
25	-0.18557	0.18970
26	-0.15550	0.16328
27	-0.12483	0.13880
28	-0.09354	0.11603
29	-0.06159	0.09480
30	-0.02892	0.07493
31	0.00449	0.05629
32	0.03876	0.03876

10. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

10.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 9.1. are not complied with.

10.2. If a Party to the 1958 Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in annex 2 of this Regulation.

11. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in annex 2 to this Regulation.

12. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS

The Parties to the 1958 Agreement which apply this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and the administrative departments which grant approval and to which, forms certifying approval or refusal or extension or withdrawal of approval, issued in other countries, are to be sent.

Annex 1

ESSENTIAL CHARACTERISTICS OF THE ENGINE AND INFORMATION CONCERNING THE CONDUCT OF TESTS

The following information, when applicable, shall be supplied in triplicate and shall include a summary.

If there are drawings, they shall be to an appropriate scale and show sufficient detail. They shall be presented in A4 format or folded to that format. In the case of microprocessor controlled functions, appropriate operating information shall be supplied.

1. Description of Engine

1.1. Manufacturer: . . . . . .

1.1.1. Manufacturer's engine code (as marked on the engine or other means of identification): . . . . . .

1.2. Internal combustion engine: . . . . . .

1.2.1. Specific engine information: . . . . . .

1.2.1.1. Working principle: positive-ignition / compression-ignition, four stroke / two stroke 1/

1.2.1.2. Number, arrangement and firing order of cylinders:

1.2.1.2.1. Bore 2/: . . . . . mm

1.2.1.2.2. Stroke 2/: . . . . . mm

1.2.1.3. Engine capacity 3/: . . . . . cm^3

1.2.1.4. Volumetric compression ratio 4/ . . . . . :

1.2.1.5. Drawing(s) of combustion chamber and piston crown: . . . . . .

1.2.1.6. Idle speed 4/:

1.2.1.7. Carbon monoxide content by volume in the exhaust gas with the engine idling: ..... per cent (according to the manufacturer's specifications) 4/

1.2.1.8. Maximum net power: ..... kW at: ..... min^{-1}

1.2.2. Fuel: leaded petrol / unleaded petrol / diesel 1/

1.2.3. RON unleaded petrol: . . . . . .

1.2.4. Fuel feed: . . . . . .

1.2.4.1. By carburettor(s): yes / no 1/

1.2.4.1.1. Make(s): . . . . . .

1.2.4.1.2. Type(s): . . . . . .

1.2.4.1.3. Number fitted: . . . . . .

1.2.4.1.4. Adjustments 4/: . . . . . .

1.2.4.1.4.1. Jets: . . . . . .

1.2.4.1.4.2. Venturis: . . . . . .

1.2.4.1.4.3. Float-chamber level: . . . . . .
1.2.4.1.4.4. Mass of float: . . . . . .
1.2.4.1.4.5. Float needle: . . . . . .
1.2.4.1.5. Cold start system: manual / automatic 1/
1.2.4.1.5.1. Operating principle: . . . . . .
1.2.4.1.5.2. Operating limits/settings 1/ 4/: . . . . . .
1.2.4.2. By fuel injection (compression-ignition only): yes / no 1/
1.2.4.2.1. System description: . . . . . .
1.2.4.2.2. Working principle: direct injection / pre-chamber / swirl chamber 1/:
1.2.4.2.3. Injection pump.
1.2.4.2.3.1. Make(s): . . . . . .
1.2.4.2.3.2. Type(s): . . . . . .
1.2.4.2.3.3. Maximum fuel delivery 1/ 4/: ..... mm^3/stroke or cycle at a pump speed of 1/ 4/: ..... min^{-1} or characteristic diagram: . . . . . .
1.2.4.2.3.4. Injection timing 4/:
1.2.4.2.3.5. Injection advance curve 4/:
1.2.4.2.3.6. Calibration procedure: test bench / engine 1/ . . . . . .
1.2.4.2.4. Governor.
1.2.4.2.4.1. Type: . . . . . .
1.2.4.2.4.2. Cut-off point: . . . . . .
1.2.4.2.4.3. Cut-off point under load: . . . . . min^{-1}
1.2.4.2.4.4. Cut-off point without load: . . . . . min^{-1}
1.2.4.2.4.5. Idling speed: . . . . . min^{-1}
1.2.4.2.5. Injector(s): . . . . . .
1.2.4.2.5.1. Make(s): . . . . . .
1.2.4.2.5.2. Type(s): . . . . . .
1.2.4.2.5.3. Opening pressure 4/: ..... kPa or characteristic diagram: . .
1.2.4.2.6. Cold start system.
1.2.4.2.6.1. Make(s): . . . . . .
1.2.4.2.6.2. Type(s): . . . . . .
1.2.4.2.6.3. Description: . . . . . .
1.2.4.2.7. Auxiliary starting aid.
1.2.4.2.7.1. Makes(s): . . . . . .
1.2.4.2.7.2. Type(s): . . . . . .
1.2.4.2.7.3. Description: . . . . . .
1.2.4.3. By fuel, injection (positive-ignition only): yes / no 1/
1.2.4.3.1. System description: . . . . . .

1.2.4.3.2. Working principle 1/: intake manifold (single / multi-point) / direct injection / other - specify)

Control unit - type or No.)
Fuel regulator - type)
Air flow sensor - type)
Fuel distributor - type)
Pressure regulator - type)
Microswitch - type)
Idle adjusting screw - type)
Throttle housing - type)
Water temperature sensor - type)
Air temperature sensor - type)
Air temperature switch - type)

Information to be given in the case of continuous injection: in the case of other systems, equivalent details.

Electromagnetic interference protection.

Description and/or drawing: . . . . . .

. . . . . .

1.2.4.3.3. Makes(s): . . . . . .

1.2.4.3.4. Type(s):

1.2.4.3.5. Injector(s): Opening pressure 4/: ..... kPa or characteristic diagram 4/:

1.2.4.3.6. Injection timing: . . . . . .

1.2.4.3.7. Cold start system: . . . . . .

1.2.4.3.7.1. Operating principle(s): . . . . . .

1.2.4.3.7.2. Operating limits / settings 1/ 4/ : . . . . . .

1.2.4.4. Feed pump.

1.2.4.4.1. Pressure 4/: ..... kPa or characteristic diagram: . . . . . .

1.2.5. Ignition.

1.2.5.1. Make(s): . . . . . .

1.2.5.2. Type(s): . . . . . .

1.2.5.3. Working principle: . . . . . .

1.2.5.4. Ignition advance curve 4/: . . . . . .

1.2.5.5. Static ignition timing 4/: ..... degrees before TDC

1.2.5.6. Contact point gap 4/: . . . . . .

1.2.5.7. Dwell angle 4/: . . . . . .

1.2.5.8. Spark plugs: . . . . . .

1.2.5.8.1. Make: . . . . . .

1.2.5.8.2. Type: . . . . . .

1.2.5.8.3. Spark plug gap setting: . . . . . mm

1.2.5.9. Ignition coil.

1.2.5.9.1. Make: . . . . . .

1.2.5.9.2. Type: . . . . . .

1.2.5.10. Ignition condenser.

1.2.5.10.1. Make: . . . . . .

1.2.5.10.2. Type: . . . . . .

1.2.6. Cooling system: liquid / air 1/

1.2.7. Intake system: . . . . . .

1.2.7.1. Pressure charger: yes / no 1/

1.2.7.1.1. Make(s): . . . . . .

1.2.7.1.2. Type(s): . . . . . .

1.2.7.1.3. Description of the system (maximum charge pressure: ..... kPa, wastegate:)

1.2.7.2. Intercooler: yes / no 1/

1.2.7.3. Description and/or drawings of inlet pipes and their accessories (plenum chamber, heating device, additional air intakes etc.): . . . . . .

1.2.7.3.1. Intake manifold description (include drawings and/or photographs): . . . . . .

1.2.7.3.2. Air filter, drawings, or,

1.2.7.3.2.1. Make(s): . . . . . .

1.2.7.3.2.2. Type(s): . . . . . .

1.2.7.3.3. Intake silencer, drawings, or,

1.2.7.3.3.1. Make(s): . . . . . .

1.2.7.3.3.2. Type(s): . . . . . .

1.2.8. Exhaust system.

1.2.8.1. Description and drawings of the exhaust system: . . . . . .

1.2.9. Valve timing or equivalent data.

1.2.9.1. Maximum lift of valves, angles of operating and closing or timing details of alternative distribution systems, in relation to dead centres: . . . . . .

1.2.9.2. Reference and/or setting ranges 1/: . . . . . .

1.2.10. Lubricant used.

1.2.10.1. Make: . . . . . .

1.2.10.2. Type: . . . . . .

1.2.11. Measures taken against air pollution.

1.2.11.1. Device for recycling crankcase gases (description and/or drawings): . . . . . .

1.2.11.2. Additional pollution control devices (if any, and if not covered by another heading):

1.2.11.2.1. Catalytic converter: yes / no 1/

1.2.11.2.1.1. Number of catalytic converters and elements: . . . . . .

1.2.11.2.1.2. Dimensions and shape of the catalytic converter(s) (volume, ...): . . . . . .

1.2.11.2.1.3. Type of catalytic action: . . . . . .

1.2.11.2.1.4. Total charge of precious metal: . . . . . .

1.2.11.2.1.5. Relative concentration: . . . . . .

1.2.11.2.1.6. Substrate (structure and material): . . . . . .

1.2.11.2.1.7.	Cell density: . . . . .
1.2.11.2.1.8.	Type of casing for catalytic converter(s): . . . . .
1.2.11.2.1.9.	Positioning of the catalytic converter(s) (Place and reference distances in the exhaust system): . . . . .
1.2.11.2.1.10.	Oxygen sensor: type: . . . . .
1.2.11.2.1.10.1.	Location of oxygen sensor: . . . . .
1.2.11.2.1.10.2.	Control range of oxygen sensor: . . . . .
1.2.11.2.2.	Air injection: yes / no 1/
1.2.11.2.2.1.	Type (pulse air, air pump, ...): . . . . .
1.2.11.2.3.	EGR: yes / no 1/
1.2.11.2.3.1.	Characteristics (flow, ...): . . . . .
1.2.11.2.4.	Evaporative emission control system.
	Complete detailed description of the devices and their state of tune: . . . . .
	Drawing of the evaporative control system: . . . . .
	Drawing of the carbon canister: . . . . .
	Drawing of the fuel tank with indication of capacity and material: . . . . .
1.2.11.2.5.	Particulate trap: yes / no 1/
1.2.11.2.5.1.	Dimensions and shape of the particulate trap (capacity): .
1.2.11.2.5.2.	Type of particulate trap and design: . . . . .
1.2.11.2.5.3.	Location of the particulate trap (reference distances in the exhaust system):
1.2.11.2.5.4.	Regeneration system/method. Description and drawing: . .
1.2.11.2.6.	Other systems (description and working principles): . . .

1/ Strike out what does not apply.

2/ This value must be rounded to the nearest tenth of a millimetre.

3/ This value must be calculated with $\pi = 3.1416$ and rounded to the nearest cm^3.

4/ Specify the tolerance.

Annex 2

COMMUNICATION
(Maximum format : A4 (210 x 297 mm))

issued by: Name of administration
.....
.....
.....

concerning: APPROVAL GRANTED 2/
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a vehicle type pursuant to Regulation No. 101

Approval No: ..... Extension No:.....

1. Trade name or mark of the vehicle: . . . . . .
2. Vehicle type: . . . . . .
3. Vehicle category: . . . . . .
4. Manufacturer's name and address: . . . . . .
5. If applicable, name and address of manufacturer's representative:
. . . . . .
6. Description of the vehicle: . . . . . .
6.1. Mass of the vehicle in running order: . . . . . .
6.2. Maximum permitted mass: . . . . . .
6.3. Type of body: saloon / estate / coupé 2/
6.4. Drive: front-wheel / rear-wheel / four-wheel 2/
6.5. Engine.
6.5.1. Cylinder capacity: . . . . . .
6.5.2. Fuel feed: carburettor / injection 2/
6.5.3. Fuel recommended by the manufacturer: . . . . . .
6.5.4. Maximum engine power: ..... kW at: ..... rpm
6.5.5. Super-charger: yes / no 2/
6.5.6. Ignition: compression ignition / positive ignition (mechanical or electronic) 2/
6.6. Transmission.
6.6.1. Type of gearbox: manual / automatic / variable transmission 2/
6.6.2. Number of gears: . . . . . .

6.6.3. Overall gear ratios (including tyre tread circumference under load): road speeds (km/h) per 1,000 engine speed (rpm):

First gear: . . . . . .

Second gear: . . . . . .

Third gear: . . . . . .

Fourth gear: . . . . . .

Fifth gear: . . . . . .

Overdrive: . . . . . .

6.6.4. Final drive ratio: . . . . . .

6.6.5. Tyres.

Type: . . . . . .

Dimensions: . . . . . .

Rolling circumference under load: . . . . . .

7. Test results.

7.1. CO_2 mass emission: . . . . . g/km

7.2. Fuel consumptions.

7.2.1. Fuel consumption (urban conditions): l/100km

7.2.2. Fuel consumption (extra-urban conditions): l/100km

7.2.3. Fuel consumption (combined): l/100km

8. Vehicle submitted for approval on: . . . . . .

9. Technical service responsible for conducting approval tests:

10. Number of report issued by that service: . . . . . .

11. Date of report issued by that service: . . . . . .

12. Approval granted / extended / refused / withdrawn 2/

13. Reasons for extension (if applicable): . . . . . .

14. Remarks: . . . . . .

15. Positioning of approval mark on the vehicle: . . . . . .

16. Place: . . . . . .

17. Date: . . . . . .

18. Signature: . . . . . .

1/ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).

2/ Strike out what does not apply.

Annex 3

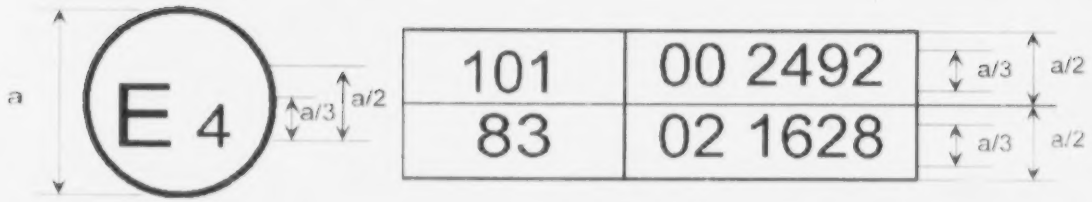
ARRANGEMENTS OF APPROVAL MARKS

Model A
(See paragraph 4.4. of this Regulation)

a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E4) with regard to the measurement of emissions of CO_2 and fuel consumption pursuant to Regulation No. 101 and under approval number 002492. The first two digits of the approval number indicate that the approval was granted according to the requirements of Regulation No. 101 in its original form.

Model B
(See paragraph 4.5. of this Regulation)



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E4) pursuant to Regulations Nos. 101 and 83 */. The first two digits of the approval numbers indicate that, at the dates when the respective approvals were given, Regulation No. 101 had not been modified and Regulation No. 83 already included the 02 series of amendments.

---

*/ The second number is given merely as an example.

Annex 4

METHOD OF MEASURING EMISSIONS OF CARBON DIOXIDE AND FUEL CONSUMPTION

1. TEST CONDITIONS

1.1. General condition of the vehicle

1.1.1. The vehicle shall have been run-in and shall have been driven for at least 3,000 km but less than 15,000 km before the test.

1.1.2. The settings of the engine and of the vehicle's controls shall be those prescribed by the manufacturer. This requirement also applies, in particular, to the idle settings (rotation speed and carbon monoxide (CO) content of the exhaust gases), to the cold start device and to the exhaust gas pollutant emission control system.

1.1.3. The laboratory may check the tightness of the inlet system to ensure that carburation is not affected by accidental intake of air.

1.1.4. The laboratory may check that vehicle performance is as specified by the manufacturer and that it is possible to use it in normal driving conditions, particularly cold and hot starts.

1.1.5. Before the test, the vehicle shall be stored in a room where the temperature remains relatively constant between 20 and 30°C. This conditioning shall be carried out for at least six hours and shall continue until the engine oil temperature and coolant, if any, have reached the temperature of the room to within ± 2°C. At the request of the manufacturer, the test shall be carried out not later than 30 hours after the vehicle has been run at its normal temperature.

1.1.6. Only the equipment necessary for the operation of the vehicle during the test shall be in use. If there is a manually controlled device for the engine intake air temperature, it shall be in the position prescribed by the manufacturer for the ambient temperature at which the test is performed. In general, the auxiliary devices required for the normal operation of the vehicle shall be in use.

1.1.7. If the radiator fan is temperature controlled, it shall be in the condition of normal operation on the vehicle. The passenger compartment heating system shall be switched off, as shall any air conditioning system, but such systems compressor shall be functioning normally.

1.1.8. If a super-charger is fitted, it shall be in the normal operating condition for the test conditions.

1.2. Lubricants.

All the lubricants shall be those recommended by the manufacturer of the vehicle and shall be specified in the test report.

1.3. Tyres.

The tyres shall be of a type specified as original equipment by the vehicle manufacturer inflated to the pressure recommended for the test load and speeds. The pressures shall be indicated in the test report.

1.4. Measurement of CO_2 and carbon-related emissions.

1.4.1. The test cycle is described in appendix 1, annex 4 of Regulation No. 83 as amended by the 01 series of amendments.

1.4.2. The load and inertia adjustments of the dynamometer are determined as defined in annex 4 of Regulation No. 83 with the exception of paragraph 5.1. and paragraph 3.3.1. of appendix 2.

For the purpose of the determination of CO_2 emissions and the related fuel consumption, the inertia weight used to adjust the dynamometer will be chosen as follows:

Reference mass of vehicle RW (kg)	Power absorbed by the dynamometer Pa (kw)	Equivalent inertia I (kg)
RW ≤ 480	3.8	455
480 < RW ≤ 540	4.1	510
540 < RW ≤ 595	4.3	570
595 < RW ≤ 650	4.5	625
650 < RW ≤ 710	4.7	680
710 < RW ≤ 765	4.9	740
765 < RW ≤ 850	5.1	800
850 < RW ≤ 965	5.6	910
965 < RW ≤ 1,080	6.0	1,020
1,080 < RW ≤ 1,190	6.3	1,130
1,190 < RW ≤ 1,305	6.7	1,250
1,305 < RW ≤ 1,420	7.0	1,360
1,420 < RW ≤ 1,530	7.3	1,470
1,530 < RW ≤ 1,640	7.5	1,590
1,640 < RW ≤ 1,760	7.8	1,700
1,760 < RW ≤ 1,870	8.1	1,810
1,870 < RW ≤ 1,980	8.4	1,930
1,980 < RW ≤ 2,100	8.6	2,040
2,100 < RW ≤ 2,210	8.8	2,150
2,210 < RW ≤ 2,380	9.0	2,270
2,380 < RW ≤ 2,610	9.4	2,270
2,610 < RW	9.8	2,270

If the corresponding equivalent inertia is not available on the dynamometer, the larger value closest to the vehicle reference mass will be used.

When using the alternative method for the setting of the dynamometer, the brake is adjusted in accordance with the values of Pa listed in the above table.

1.4.3. Calculation of emissions.

1.4.3.1. The emissions of gaseous pollutants are calculated by means of the following equation:

$$M_i = \frac{V_{mix} \cdot Q_i \cdot C_i \cdot 10^{-6}}{d} \qquad (1)$$

where:

M_i = mass emission of the pollutant i in grams per kilometre;

V_{mix} = volume of the diluted exhaust gas expressed in litres per test and corrected to standard conditions (273.2 K and 101.33 kPa);

Q_i = density of the pollutant i in grams per litre at normal temperature and pressure (273.2 K and 101.33 kPa);

C_i = concentration of the pollutant i in the diluted exhaust gas expressed in ppm and corrected by the amount of the pollutant i contained in the dilution air. If C_i is expressed in per cent volume, 10^{-6} factor is replaced by 10^{-2}.

D = driven distance during the operating cycle in kilometres.

1.4.3.2. Volume determination.

1.4.3.2.1. Calculation of the volume when a variable dilution device with constant flow control by orifice or venturi is used. Record continuously the parameters showing the volumetric flow and calculate the total volume for the duration of the test.

1.4.3.2.2. Calculation of volume when a positive displacement pump is used. The volume of diluted exhaust gas in systems comprising a positive displacement pump is calculated with the following formula:

$$V = V_O \cdot N$$

where:

V = volume of the diluted exhaust gas expressed in litres per test (prior to correction);

V_O = volume of gas delivered by the positive displacement pump on testing conditions in litres per revolution;

N = number of revolutions per test.

1.4.3.2.3. Correction of the diluted exhaust gas volume to standard conditions. The diluted exhaust gas volume is corrected by means of the following formula:

$$V_{mix} = V \cdot K_1 \cdot \frac{P_p}{T_p} \quad (2)$$

in which:

$$K_1 = \frac{273.2}{101.33} = 2.6961 \ (K \cdot kPa^{-1}) \quad (3)$$

where:

P_p = absolute pressure at the inlet to the positive displacement pump in kPa;

T_p = average temperature of the diluted exhaust gas entering the positive displacement pump during the test (K).

1.4.3.3. Calculation of the corrected concentration of pollutants in the sampling bag.

$$C_i = C_e - C_d \left(1 - \frac{1}{DF}\right) \quad (4)$$

where:

C_i = concentration of the pollutant i in the diluted exhaust gas, expressed in ppm or per cent volume and corrected by the amount of i contained in the dilution air;

C_e = measured concentration of pollutant i in the diluted exhaust gas, expressed in ppm or per cent volume;

C_d = measured concentration of pollutant i in the air used for dilution, expressed in ppm or per cent volume;

DF = dilution factor.

The dilution factor is calculated as follows:

$$DF = \frac{13.4}{C_{CO2} + (C_{HC} + C_{CO}) \ 10^{-4}} \quad (5)$$

where:

C_{CO2} = concentration of CO_2 in the diluted exhaust gas contained in the sampling bag, expressed in per cent volume;

C_{HC} = concentration of HC in the diluted exhaust gas contained in the sampling bag, expressed in ppm carbon equivalent;

C_{CO} = concentration of CO in the diluted exhaust gas contained in the sampling bag, expressed in ppm.

1.4.3.4. Example.

1.4.3.4.1. Data.

1.4.3.4.1.1. Ambient conditions:

Ambient temperature: 23°C = 296.2 K,

Barometric pressure: P_B = 101.33 kPa.

1.4.3.4.1.2. Volume measured and reduced to standard conditions:

V = 52,961 litres

1.4.3.4.1.3. Analyser readings:

	Diluted exhaust	Dilution air
HC 1/	92 ppm	3.0 ppm
CO	470 ppm	0 ppm
CO_2	1.6 % volume	0.03 % volume

1/ in ppm carbon equivalent.

1.4.3.4.2. Calculation.

1.4.3.4.2.1. Dilution factor (DF) (see formula 5):

$$DF = \frac{13.4}{C_{CO2} + (C_{HC} + C_{CO}) \cdot 10^{-4}}$$

$$DF = \frac{13.4}{1.6 + (92 + 470) \cdot 10^{-4}}$$

$$DF = 8.091$$

1.4.3.4.2.2. Calculation of the corrected concentration of pollutants in the sampling bag:

HC Mass emissions (see formulae 4 and 1):

$$C_i = C_e - C_d \left(1 - \frac{1}{DF}\right) \quad (4)$$

$$C_{HC} = 92 - 3 \times \left(1 - \frac{1}{8.091}\right)$$

$$C_{HC} = 89.371 \ ppm$$

$$M_{HC} = C_{HC} \cdot V_{mix} \cdot Q_{HC} \cdot \frac{1}{d} \cdot 10^{-6} \quad (1)$$

where:

$$Q_{HC} = 0.619$$

$$M_{HC} = 89.371 \times 51,961 \times 0.619 \times 10^{-6} \times \frac{1}{d}$$

$$M_{HC} = \frac{2.88}{d} \ g/km$$

CO mass emissions (see formula 1):

$$M_{CO} = C_{CO} \cdot V_{mix} \cdot Q_{CO} \cdot \frac{1}{d} \cdot 10^{-6} \quad (1)$$

where:

$$Q_{CO} = 1.25$$

$$M_{CO} = 470 \times 51,961 \times 1.25 \times 10^{-6} \times \frac{1}{d}$$

$$M_{CO} = \frac{30.5}{d} \quad g/km$$

CO_2 mass emissions (see formula 1):

$$C_1 = C_e - C_d\left(1 - \frac{1}{DF}\right) \qquad (4)$$

$$C_{CO2} = 1.6 - 0.03 \times \left(1 - \frac{1}{8.091}\right)$$

$$C_{CO2} = 1.573 \ \% \ volume$$

and:

$$Q_{CO2} = 1.964$$

$$M_{CO2} = C_{CO2} \cdot V_{mix} \cdot Q_{CO2} \cdot 10^{-2} \cdot \frac{1}{d} \qquad (1)$$

$$M_{CO2} = 1.573 \times 51,961 \times 1.964 \times 10^{-2} \times \frac{1}{d}$$

$$M_{CO2} = \frac{1,605.27}{d} \quad g/km$$

1.4.3.5. Special provisions relating to vehicles equipped with compression-ignition engines.

HC Measurements for compression-ignition engines.

The average HC concentration used in determining the HC mass emissions from compression-ignition engines is calculated with the aid of the following formula:

$$C_e = \frac{\int_{t_1}^{t_2} C_{HC} \cdot dt}{t_2 - t_1} \qquad (7)$$

where:

$\int_{t_1}^{t_2} C_{HC} \cdot dt$ = integral of the recording of the heated FID on the test duration $(t_2 - t_1)$

C_e = HC concentration of the diluted exhaust gas sample as calculated from the integrated HC trace, in ppm carbon equivalent.

1.5. Calculation of fuel consumptions.

1.5.1. The fuel consumptions are calculated from the emissions of hydrocarbons, carbon monoxide and carbon dioxide in accordance with paragraph 1.4. of this annex.

1.5.2. The fuel consumption expressed in litres per 100 km are calculated using the following formulae:

(a) for petrol engined vehicles:

$$FC = \frac{0.1154}{D} [(0.866 \cdot HC) + (0.429 \cdot CO) + (0.273 \cdot CO_2)]$$

(b) for diesel engined vehicles:

$$FC = \frac{0.1155}{D} [(0.866 \cdot HC) + (0.429 \cdot CO) + (0.273 \cdot CO_2)]$$

where:

FC = fuel consumption in litres per 100 km;

HC = measured emission of hydrocarbons in g/km;

CO = measured emission of carbon monoxide in g/km;

CO_2 = measured emission of carbon dioxide in g/km

D = density of the test fuel.